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RESPONSE OF TOMATO PLANTS TO FERTILIZATION AND IRRIGATION TREATMENTS

BY

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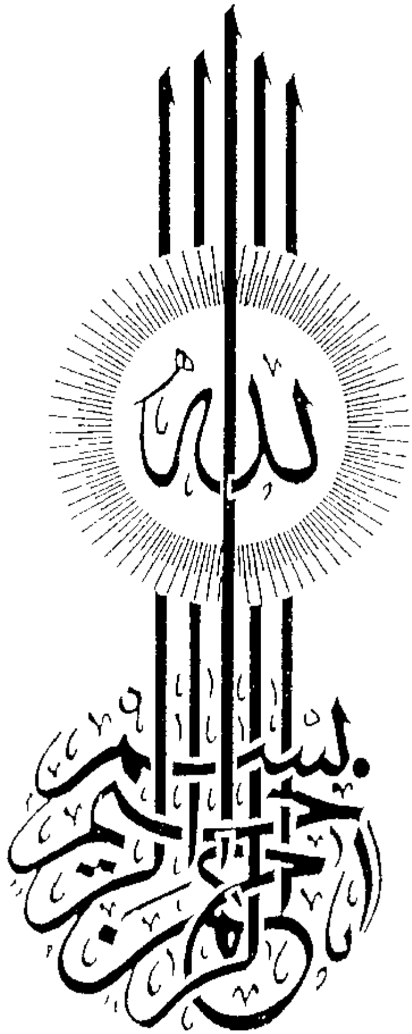

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I. INTRODUCTION

In arid regions where water is scarce, irrigations should be planded to maximize crop production per unit of applied water. In such areas criteria needed for irrigation scheduling and for determining the crop water requirements impose the need to study and measure water status in the continuous soil plant atmosphere system. Since efficient crop production depends on timely availability of water, any water conservation practice which enhances this availability should be useful. Under conditions of drought the continued loss of soil water by evapotranspiration can lead the development of plant water deficits which can reduce growth and yield eventually by fatal to the plant. Transpiration is the main path-way of water loss from fields of irrigated crops, particularly under arid and semi-arid regions. Approximately 99% of the water taken up by plant roots is transpired to the atmosphere through stomatal pores in the leaves (Davenport and Hagan,1982).

Since stomata are located at a point in the water path-way where the vapour-pressure gradient is steepest, i.e., between the leaf and the atmosphere,

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the stomata-bearing leaf surfaces are the most strategic sites for water control. Transpiration may be reduced by the applications of chemical compounds act by inhibiting stomatal opening, or produce on external physical barrier to retard the escape of water vapour from plants (Gale, 1961).

The objective of this work was to investigate the effect of stressed and non-stressed soil moisture conditions on the growth, water use efficiency, and nutrient contents of tomato or squash plants. Also the effect of antitranspirants was investigated under this conditions.

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II. REVIEW OF LITERATURE

II.1. Effect of water stress on plant growth:

An internal water stress in crop plants sufficient to reduce their productivity, this reduction in productivity is brought about by a delay or prevention of crop establishment, weakening or destruction of established crops, predisposition of crops to insects and disease, alteration of physiological and biochemical metabolism in plants, and alteration of the quality of the grain, forage, fibre, oil and other sought-for products (Larson and Eastin, 1971).

Several functions of water in plants have been well-established (Russell and Shorrocks 1959).

Growth is reduced by a decrease of relative turgidity below 90% and is approximately half of the normal growth rate when the relative turgidity reaches 85 to 83% (Mitchell, 1970).

Larson, (1982) suggested that the role of water in total growth, it is apparent, a deficiency of water

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will influence the growth of different organs in various ways: 1) a decrease in the ratio of shoot to root growth, 2) a decrease in the proportion of lateral roots to the total root length, and, 3) a decrease in ratio of leaf to stem. He added that plants may resist drought stress by their ability to maintain a high internal water content. This is accomplished by a deep and extensive root system or reduced rate of transpiration by the presence of a very thick and highly impermeable cuticle and closure of stomata during the hot and dry periods. Water stress can affect photosynthesis directly, by affecting various biochemical processes involved in photosynthesis, and indirectly, by reducing the intake of CO_2 through stomata as a result of their closure in response to water stress. The Translocation of assimitates can also be affected by water stress, and the resulting assimilate saturation in the leaves may limit photosynthesis (Hartt, 1967).

Mineral uptake is frequently reduced in drought stressed plants (Slatyer, 1969).

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Brix, (1962) suggested that stomatal closure is influenced by water deficits as turgidity of the gard cell is dependent on water content. Net photosynthesis is reduced by water stress, partially by a direct effect of dehydration on the photosynthetic system, drought stress has been shown to reduce translocation from the leaves, and as drought hastens maturation, this response in addition to reduced photosynthesis contributes to lower grain yield, (Larson, 1982).

Mederski and Jeffrs, (1973) reported that under high moisture stress conditions, the yield of the most stress resistant varieties of soybeans was reduced by about 20% while the yield of the least stress resistant varieties was reduced by about 40%.

Oppenheimer (1960) found that resistant wheat cultivars retained more water in the plant under this high stress than non-resistant ones.

Chinoy, (1947) found that Indian cultivars resisted wilting at the beginning of tillering and that stress at this stage increased yield over those not wilted.

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Chinoy, (1962) claimed later that severe stress was not useful in showing differences in resistance of cultivars.

Wells and Dubetz (1966) showed that the effect of stress was greatest at anthesis and that moderate stress was useful in classifying drought resistance of cultivars.

Wardlaw (1971) findings agree that anthesis is the critical stage. Stress reduced photosynthesis and root growth and thus reduced final grain weight per ear.

Kaul (1973) has shown that some wheat cultivars are damaged by stress of about -24 bars and their ability to grow has been irreversibly damaged; while others recover from stresses as high as -40 bars.

Kramer (1963) emphasized that plant growth depends directly upon plant water stress and only indirectly on soil water stress.

Plant water stress depends on rate of water absorption and water loss. (Hurd and Spratt, 1982).

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Kramer (1963) describe how water stressed reduced growth, outlines them as follows :

(1) It is a major constituent of physiologically active tissue.

(2) It is the reagent in photosynthesis and in hydrolytic processes such as starch digestion.

(3) It is the solvent in which salts, sugars and other solutes move from cell to cell and organ to organ.

(4) It is essential for maintenance of the turgidity necessary for cell enlargement and growth.

Hurd and Spratt, (1982) suggested that water stress often increases root/shoot ratio, and leaf area is reduced but thickness increased. They added that it reduced photosynthesis directly by lowering protoplasm capacity and indirectly by less leaf area and closed stomata, Slatyer (1973a) states that photosynthesis is progressively reduced by water stress. It sometimes causes increased respiration.

Begg and Turner, (1976) suggested that plant growth is controlled directly by the components of the

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total water potential and only indirectly by the total water potential. Water potential is important in brining water to the cell (Gale, 1975), once there, the turgor pressure and osmotic potential become important for growth (Wieb, 1972).

Water stress may reduced photosynthesis dramatically for a short period but upon rewatering photosynthesis recovers, where a gradual and possibly irreversible reduction in leaf area can have a significant effect on growth, development, and yield (Begg and Turner, 1976).

II.2. Role of transpiration:

Transpiration is an extremely important physiological process because water movement in the xylem is essential to nutrient distribution in the plants.

Transpiration produces the energy gradient which causes movement of water into and through plants, and the translocation of organic and inorganic materials between cells. However, water movement in the xylem is considerably excess of that required for adequate nutrient transport (Crafts, 1968).

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Hygen, (1953) suggested that transpiration is considered an unavoidable evil, because the entrance of carbon dioxide into the leaf for photosynthesis is essential; a plant structure that makes this possible will inevitably make possible water loss through transpiration.

Penman, (1952) found that maximum rates of photosynthesis and growth are related to a maximum rate of transpiration. Although reduced transpiration is the primary goal of applying anti-transpirants, that goal may be sough for considerably different reasons:

1) Conservation of water supplies, particularly where water is scarce and costly; or 2) improved plant performance via an increase in plant water potential. (Davenport and Hagan, 1982).

Hurd and Spratt, (1982) found that transpiration rate is controlled by leaf area and structure, extent of stomatal opening, and environmental factors which affect steepness of water vapour pressure gradient such as temperature and vapour pressure of the atmosphere.

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II.2.2. <u>Effect of transpiration on nutrient uptake</u>:

Bray (1954) described nutrient mobility in soils by mass flow, those ions which could move over relatively large distances (mobile nutrients) and those which could only move a few millimetres (immobile nutrients). The nutrients which are not adsorbed by the soil colloids and exist primarily in the soil solution such as NO_3, Cl, and SO_4, move with the soil water and are absorbed by the root when water is absorbed. The level of particular nutrient around the root may be increased, decreased or remains the same depending on the balance between the soil of its supply to the root by mass flow and the rate of uptake by the root, (Barber, 1962).

Mass flow plays an important role for nutrients, present in soil solution in high concentration and when transpiration is high. Under such conditions consideration quantities of water are moved to the roots carrying various solutes.

Barber (1962) and Barber et al. (1963) demonstrated large differences in the amounts of the various ions transported by mass flow.

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